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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

Fireworks Assembler (Fireworks) 737.887;

S-52

U. S. Employment Service in
Cooperation with
Texas State Employment Service

TM 001 249

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
June 1954

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY
FOR
Fireworks Assembler (Fireworks) 737.887-050

S-52

Summary

The entire GATB, B-1001, was administered during the period of May 21, 1952 to March 16, 1953 for a longitudinal experimental design test development study to 141 women who were subsequently trained on the job for the assembly of pyrotechnic devices at the Monarch Manufacturing Company of Fort Worth, Texas. Of these 141 women tested, 75 were selected on the basis of job comparability for the final sample to establish test norms for the occupation Fireworks Assembler 737.887. The criterion consisted of broad category supervisory ratings. On the basis of high means, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes F - Finger Dexterity and M - Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Fireworks Assembler (Fireworks)

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Fireworks Assembler (Fireworks) 737.887

TABLE I

Minimum Acceptable Score on B-1001 and B-1002 for B-292

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
F	CB-1-O CB-1-P	100	F	Part 11 Part 12	95
M	CB-1-M CB-1-N	100	M	Part 9 Part 10	95

Effectiveness of Norms

The data in Table IV indicate that 20 of the 25 poor workers, or 80% of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 80% of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 48 of the 53 workers who made qualifying test scores, or 91%, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and the minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Fireworks Assembler (Fireworks) 737.887

II. Sample

During the period of May 21, 1952 to March 16, 1953, the entire GATB, B-1001, was administered for a longitudinal experimental design test development study to 141 women applicants at the Monarch Manufacturing Company at Fort Worth, Texas. These women were pretested with the GATB before being hired, but were hired without regard to test scores and given on-the-job training in the assembly of pyrotechnic devices. Of these 141 women tested with the GATB, B-1001, 75 were selected on the basis of job comparability for the final sample to establish test norms for the occupation of Fireworks Assembler (Fireworks) 737.887

The supervisory ratings used as the criterion were made on August 11, 1953 at which time company officials considered all personnel to have reached their maximum proficiency in the assembly of all the products. Since March 1953 was the last date during which applicants in the sample were tested, all workers were beyond the trainee stage for this job when the ratings were made.

Table II shows the means, standard deviations, Pearson product-moment correlations (corrected for broad categories) with the criterion and the standard errors of correlation for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{o}r$) and the Standard Errors of Correlation ($\sigma_{o}r$) for Age, Education, and Experience

Fireworks Assembler (Fireworks) 737.887

N = 75

	M	σ	Range	$_{o}r$	$\sigma_{o}r$
Age (years)	35.9	7.8	21-59	-.415	.096
Education (years)	11.6	.9	8-12	.020	.115
Experience (months	8.7	2.0	5-15	-.214	.110

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The data in Table II show that there is a significant negative correlation between age and the criterion. To determine whether or not age was exerting an undue influence on the ratings, additional calculations were made. Pearson product-moment correlations were computed to show the relationship between age and the two aptitudes finally selected for the test battery for the occupation of FIREWORKS Assembler, Finger Dexterity and Manual Dexterity. A correlation of -.503 with a standard error of .086 was obtained between age and Finger Dexterity; a correlation of -.342 with a standard error of .102 was obtained between age and Manual Dexterity. These correlations indicate that age did not exert an undue influence on the ratings, but that the older workers tended to have a lower degree of the aptitudes found to be important for the job of FIREWORKS ASSEMBLER and, therefore, probably did not perform it as well and were validly assigned lower criterion ratings. The age range for this sample is relatively wide, but apparently the data for this sample are suitable for test development purposes.

III. Job Description

Job Title: FIREWORKS ASSEMBLER (FIREWORKS) 737.887-050

Job Summary: Performs one or more of a series of tasks in the assembly of pyrotechnic devices, such as signal flares, booby traps, practice hand grenades, and aircraft landing flares.

Work Performed

Obtains tray containing 50 small aluminum tubes in which the primer has been installed and waterproofed, places tray on work bench and loads each tube with a propelling charge of black powder by scooping up powder with a volumetric measuring device and dumping into tube using one hand.

Installs paperboard disc or spacer and felt washers on top of black powder in each aluminum tube, using fingers of either hand and pushing into place with a small wooden plunger tool.

Installs illuminant assembly with proper spacers on top of discs above black powder in the loaded tube, using both hands to fit in proper space.

Installs top-sealing paperboard or plastic disc in aluminum tube, using a small hand operated arbor press to crimp and seal into place.

Assembles component parts of various types of pyrotechnics such as filled tubes (tubes within tubes), discs, whistles, pull igniters, quickmatches, scratch pads, match heads and other components, using both hands to perform simple assembly operations and joining with rubber cement, glue or tape.

Inspects each item for proper assembly, labels it and packs a specified number of assembled units in cardboard boxes for next operation.

Keeps production records, listing sub-lot and operation number, time started and time finished, and attaches the record to each lot assembled.

IV. Experimental Battery

All of the tests of the GATB, B-1001, were administered to the sample group.

V. Criterion

The criterion consisted of supervisory ratings made by the personnel director and time and cost personnel who knew all people in the plant and were familiar with the job performance of each worker. Each worker was rated according to job ability and classified into one of three categories as "high," "medium," or "low." There were twenty-five workers placed in each of the three categories. For statistical analysis, these broad category ratings were converted to quantitative scores. The "high," "medium," and "low" categories were assigned scores of 61, 50, and 39, respectively.

VI. Statistical and Qualitative Analysis

Means, standard deviations, and Pearson product-moment correlations (corrected for broad categories) with the criterion were calculated for the aptitude scores. The aptitudes which make up the final norms were selected on the basis of these statistical data as well as on the basis of job analysis data.

Table III shows the means, standard deviations, Pearson product-moment correlations (corrected for broad categories) with the criterion, and standard errors of correlation for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) and Standard Errors of Correlation ($\sigma_{c}r$) for the Aptitudes of the GATB

FIREWORKS ASSEMBLER (FIREWORKS) 737.887

N = 75

Aptitudes	M	σ	$_{c}r$	$\sigma_{c}r$
G - Intelligence	92.8	15.5	.388	.098
V - Verbal Aptitude	92.1	16.4	.051	.113
N - Numerical Aptitude	89.6	18.7	.552	.080
S - Spatial Aptitude	97.9	17.1	.351	.101
P - Form Perception	90.4	16.4	.402	.097
Q - Clerical Perception	85.2	16.7	.446	.093
A - Aiming	88.0	22.1	.502	.086
T - Motor Speed	88.4	21.4	.426	.095
F - Finger Dexterity	112.6	16.8	.690	.060
M - Manual Dexterity	116.9	18.2	.569	.078

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The statistical results were interpreted in conjunction with job analysis data. On the basis of job analysis data, it appears that the most important aptitude requirements for FIREWORKS ASSEMBLER are as follows:

Finger Dexterity (F) - to manipulate small objects in performing various assembly operations, such as assembling component parts of various types of pyrotechnics, and to pack assembled units into cardboard boxes.

Manual Dexterity (M) - to perform any one or a combination of the following operations: scooping up charges of powder and dumping powder into aluminum tubes by hand; pushing discs and felt washers into powder filled tubes with plunger tool; using a small hand operated arbor press for crimping and sealing operations; assembling parts of pyrotechnics; and packing assembled units into boxes.

Aptitudes F - Finger Dexterity and M - Manual Dexterity warrant consideration for inclusion in the test norms on the basis of statistical data as well as on the basis of job analysis data. Aptitudes F and M have the highest means, 112.6 and 116.9, respectively, and show the highest correlations with the criterion, .690 and .569, respectively, which are both at the .01 level of significance.

Other aptitudes which warranted consideration for inclusion in the test norms are Form Perception (P), Aiming (A), and Motor Speed (T). All have significant correlations with the criterion, but the mean scores for these aptitudes, which range from 88.0 to 90.4, are below the general population mean of 100 and are also substantially below the mean scores of 112.6 and 116.9 for Aptitudes F and M respectively. Furthermore, even though these aptitudes show significant correlations with the criterion, all are substantially lower than the correlations obtained for Aptitudes F and M. It was also found that the selective efficiency of norms which include Aptitudes F and M was lowered by the addition of Aptitude P, A or T or any combination of these aptitudes. In addition, job analysis data indicate that Aptitudes P, A, and T are relatively unimportant for successful job performance as compared to Aptitudes F and M. Although Form Perception, Aiming and Motor Speed are involved, the work appears to be fairly routine and makes no unusual demands in terms of discrimination of sizes and shapes of objects, coordination, or reaction time.

On the basis of all factors considered, including both statistical and qualitative considerations, Aptitudes F and M were chosen for inclusion in the test norms. Computations were made to determine the predictive value of these aptitudes with various cutting scores. A highly significant relationship was found between Aptitudes F and M with a critical score of 100 for each of these two aptitudes. The minimum score for Aptitude M was set at one standard deviation below the mean and then rounded to the nearest five-point score level. The minimum score for Aptitude F was set at one standard deviation below the mean rounded to the higher adjacent five-point score level in order to obtain better selective efficiency.

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For the purpose of computing a tetrachoric correlation coefficient and Chi Square value, the criterion was dichotomized with those workers rated "high" and "medium" in job performance placed in the high criterion group, and with those workers rated "low" placed in the low criterion group.

Table IV shows the relationship between the dichotomized criterion and aptitudes F and M, each with a critical score of 100, for Fireworks Assembler 737.887 Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship Between Test Norms Consisting of Aptitudes F and M, Each with a Critical Score of 100, and the Criterion for Fireworks Assembler (Fireworks) 737.887

N = 75

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	2	48	50
Poor Workers	20	5	25
Total	22	53	75

$r_{tet} = .96$ $\quad X^2 = 42.847$

$\sigma_{r_{tet}} = .20$ $\quad P/2 < .0005$

The data in Table IV yield a tetrachoric correlation coefficient of .96 with a standard error of .20, and a Chi Square value of 42.847 which corresponds to a P/2 value of less than .0005, indicating a highly significant relationship between the recommended norms and the criterion.

VII. Conclusions

On the basis of mean scores, correlation coefficients, job analysis data and their combined predictive efficiency, it is recommended that Aptitudes F and M, each with a minimum score of 100, be used as B-1001 norms for Fireworks Assembler (Fireworks) Equivalent B-1002 norms consist of F - 95 and M - 95.